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ENGINEERING AND DESIGN COST/RATE FORECASTING SYSTEM. VOLUME II.--ETC(U)
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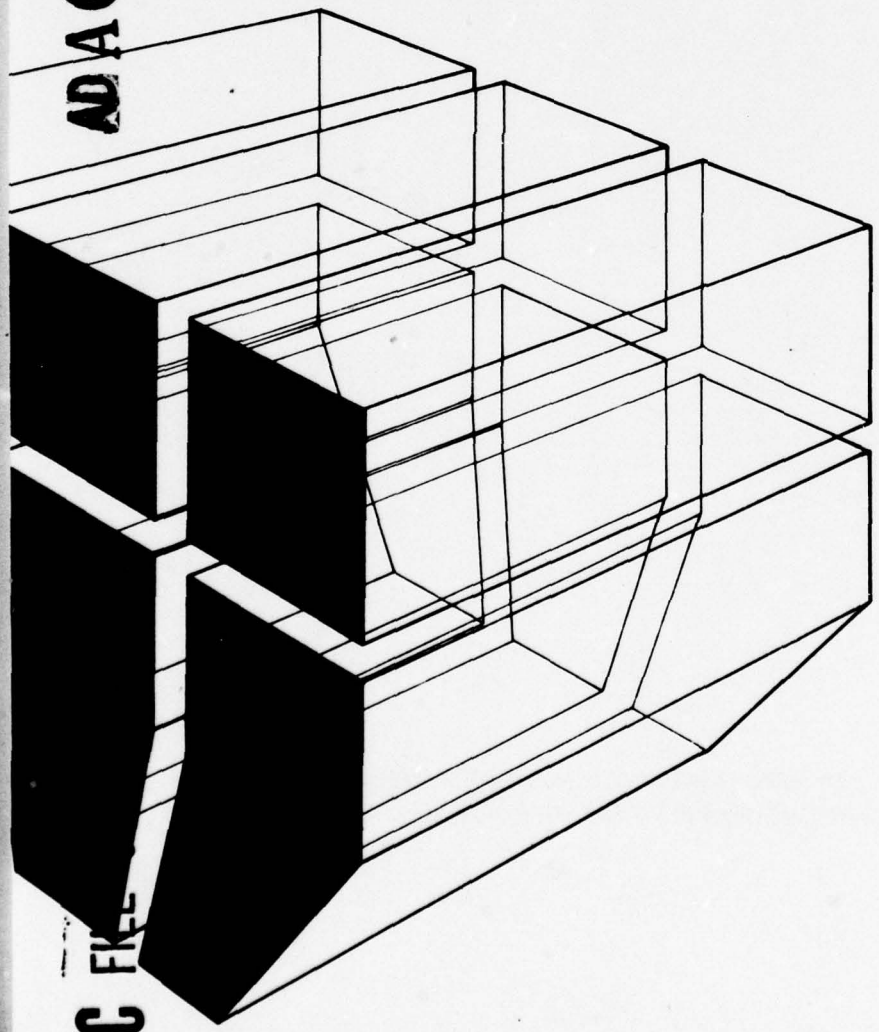
TECHNICAL REPORT P-94
September 1978

LEVEL II

ENGINEERING AND DESIGN COST/RATE FORECASTING SYSTEM, VOLUME II: USER'S MANUAL



by
R. D. Neathammer

CERL

COMPUTER PROGRAM DATA SHEET

Title: Engineering and Design (E&D) Cost/Rate Forecasting System

Proponent: Directorate of Military Construction Data Processing Installation: Construction Division of MC Operations and Planning Branch

Language: BASIC

Hardware: TEKTRONIX 4051

Availability: Corps of Engineers Engineering Computer Programs Library

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number): This volume describes the use of the Engineering and Design (E&D) Cost/Rate Forecasting System to maintain E&D data, to update the E&D forecasting model, and to forecast future E&D costs and rates. Volume I provides information on the model development and data analysis.	

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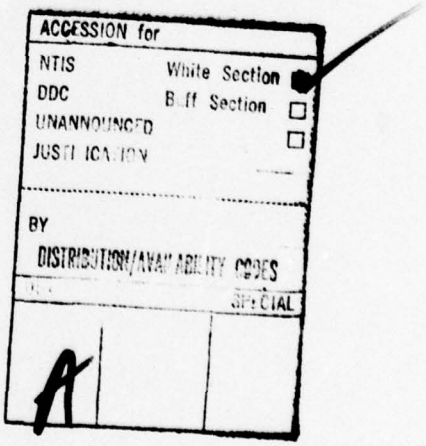
FOREWORD

This research was conducted for the Directorate of Military Construction, Office of the Chief of Engineers (OCE), under O&MA FAD No. 78-1 dated 1 October 1977, and FAD Change No. 1 dated 29 November 1977. The OCE Technical Monitor was Mr. David A. Spivey, DAEN-MCC-C.

The work was performed by the Facility Systems Division (FS), U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, IL. The Principal Investigator was Mr. Robert D. Neathammer. The computer programming was performed by Mr. Robert Lidral and Mr. Lincoln Little, both of CERL. Mr. E. A. Lotz is Chief of FS.

COL J. E. Hays is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.



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FORECASTING SYSTEM--VOLUME II: USER'S MANUAL

1 INTRODUCTION

Background

Recently, the Office of the Chief of Engineers (OCE) requested that the Construction Engineering Research Laboratory (CERL) develop methods to predict contract and in-house engineering and design (E&D) costs. CERL developed a statistical model for E&D costs/rates forecasting to help the Directorate of Military Construction (DMC) establish E&D limits for each Military Construction Division and District, as discussed in Volume I. The E&D Cost/Rate Forecasting System is a computer program which provides DMC with the capability to maintain, update, and use the E&D forecasting model. The system maintains and updates estimated costs of construction and E&D cost data for each Military Construction Division and District for 9 fiscal years. It performs multiple linear regression analyses on these data to update the statistical models for predicting E&D costs and rates and provides 95 percent prediction limits for each Division/District. The E&D Cost/Rate Forecasting System is implemented on a TEKTRONIX 4051 in BASIC. Programs and data reside on tape cassettes.

Objective

The objective of this report is to describe and provide examples of commands for the E&D Cost/Rate Forecasting System program and to explain the general system use.

Outline of Report

Chapter 2 provides general instructions for system use, and Chapter 3 describes system commands.

2 GENERAL SYSTEM USE

Three types of E&D costs are forecast by the system: (1) contract, (2) in-house, and (3) total. In this manual, the term "E&D" represents any of the three types of E&D costs; all three types are on one cassette: total in databases 1-9, in-house in databases 21-39, and contract in databases 41-49.

The E&D cost/rate forecasting system is loaded by inserting the tape cassette on which it resides into the TEKTRONIX 4051 and pressing AUTO LOAD. Once loaded, the program displays the system menu and prompts the user for further input, as illustrated in Figure 1. For example, if the user wishes to display the data for total E&D costs for Alaska, he/she should respond by typing "4,1". The execution of any command causes the menu to be cleared from the screen and appropriate command information to be displayed. Each command display includes the description of the command being executed and the name of the database on which it is operating. Prompts for additional user action and the output from the command are displayed as appropriate. Completion of each command is indicated by the prompt for a new command. Upon detection of an error, an error message is displayed and the processing of the command or subcommand is terminated. If an error occurs which is not handled by the system and thus aborts the program, recovery may be accomplished easily by pressing AUTO LOAD; results of previous, successful commands will still be valid.

ENGINEERING AND DESIGN COST/RATE
FORECASTING SYSTEM

COMMANDS

ID	DESCRIPTION
1	ADD A DIVISION/DISTRICT DATABASE
2	DELETE A DIVISION/DISTRICT DATABASE
3	CHANGE A DIVISION/DISTRICT DATABASE
4	DISPLAY A DIVISION/DISTRICT DATABASE
5	PERFORM REGRESSION ANALYSIS
6	DISPLAY MODEL EQUATION AND STATISTICS
7	PLOT E&D COST/RATE CURVES
8	FORECAST E&D COST/RATE

DATABASES

ID	NAME	ID	NAME
1	ALASKA (TOTAL)	2	BALTIMORE (TOTAL)
3	FORT WORTH (TOTAL)	4	MOBILE (TOTAL)
5	NEW YORK (TOTAL)	6	OMAHA (TOTAL)
7	PACIFIC (TOTAL)	8	SACRAMENTO (TOTAL)
9	SAVANNAH (TOTAL)	21	ALASKA (INHOUSE)
22	BALTIMORE (INHOUSE)	23	FORT WORTH (INHOUSE)
24	MOBILE (INHOUSE)	25	NEW YORK (INHOUSE)
26	OMAHA (INHOUSE)	27	PACIFIC (INHOUSE)
28	SACRAMENTO (INHOUSE)	29	SAVANNAH (INHOUSE)
41	ALASKA (CONTRACT)	42	BALTIMORE (CONTRACT)
43	FORT WORTH (CONTRACT)	44	MOBILE (CONTRACT)
45	NEW YORK (CONTRACT)	46	OMAHA (CONTRACT)
47	PACIFIC (CONTRACT)	48	SACRAMENTO (CONTRACT)
49	SAVANNAH (CONTRACT)		

ENTER "<COMMAND ID>" <DATABASE ID>
OR "M" FOR MENU OR "Q" TO QUIT
>

Figure 1. System menu display.

3 COMMANDS

Add a Division/District Database

This command is used to add a new database to the system. The new database ID must not be the same as the ID of any existing database and must be a positive integer between 1 and 99, inclusive; in addition, the database name must not be the same as that of any existing database. The system will prompt the user for the database name and data as illustrated in Figure 2. A database name may be any alphanumeric string up to 20 characters long.

Delete a Division/District Database

This command deletes the entire nine-record database for the specified Division/District. To prevent accidental deletions, this command prompts the user to verify that he/she really wishes to delete the dataset. Figure 3 is an example of this command.

Change a Division/District Database

This command is used to change data records and to add the newest record (or oldest), and to delete the oldest (or newest) record in the existing database. The system issues the following prompt:

The fiscal year must be a two-digit number equal to either (1) one of the years in the existing database, (2) 1 year earlier than the earliest year, or (3) 1 year later than the latest existing year. The estimated cost of construction and E&D cost are decimal numbers that express the costs in millions of dollars. If the fiscal year entered by the user matches the fiscal year of an existing data record, then that record's data will be replaced with the new input data after the user is prompted for verification. If the fiscal year is one greater than the most recent or one less than the least recent, then the whole database is shifted 1 year to accommodate the new data, deleting the record at the opposite end of the database (in either case, the user is informed of the deletion). If all three values are zero, the command terminates. Upon successful completion of a change transaction (other than one with three zeroes), the change prompt is reissued. Changes to a Division/District database will "zero out" the previously existing forecasting model for that Division/District to insure that all forecasts are based on the current database. Figure 4 is an example of how this command is used.

```
ADD A DIVISION/DISTRICT DATABASE

DATABASE ID = 1

ENTER "<DATABASE NAME>"
>ALASKA (TOTAL)

DATA FOR 9 CONSECUTIVE YEARS MUST BE ENTERED IN ASCENDING ORDER (2 DIGIT
FY, COST IN MILLIONS)

ENTER RECORD 1:  "<FY>, <ESTIMATED COST OF CONSTRUCTION>, <E&D COSTS>"
>69, 17.498, 1.157
ENTER RECORD 2 FOR FY70:  "<ESTIMATED COST OF CONSTRUCTION>, <E&D
COSTS>"
>16.238, 1.201
.
.
.
ENTER RECORD 9 FOR FY77:  "<ESTIMATED COST OF CONSTRUCTION>, <E&D
COSTS>"
>38.552, 2.654

ENTER "<COMMAND ID>, <DATABASE>"
OR "M" FOR MENU OR "Q" TO QUIT
>
```

Figure 2. Add a Division/District database command.

```
DELETE A DIVISION/DISTRICT DATABASE


DATABASE 1 FOR DIVISION/DISTRICT ALASKA
TYPE "YES" TO DELETE, ANYTHING ELSE TO LEAVE AS IS
>YES
DATABASE 1 FOR DIVISON/DISTRICT ALASKA DELETED


ENTER "<COMMAND ID>, <DATABASE ID>"
OR "M" FOR MENU OR "Q" TO QUIT
```

Figure 3. Delete a Division/District database command.

```
CHANGE A DIVISION/DISTRICT DATABASE
CHANGE DATABASE 1 FOR DIVISION/DISTRICT ALASKA


ENTER DATABASE CHANGES: TO TERMINATE, ENTER THREE ZEROES
ENTER "<FY>, <COST OF CONSTRUCTION >, <E&D COST>"
>64, 24.3, 1.6
ADDING YEAR TO BEGINNING OF DATA; LAST YEAR DISCARDED
ENTER "<FY>, <COST OF CONSTRUCTION>; <E&D COST>"
>68, 21.731, 1.636
CHANGING DATA FOR FY68
DO YOU WISH TO CHANGE THIS DATA (YES OR NO)?
YES
ENTER "<FY>, <COST OF CONSTRUCTION>, <E&D COST>"
>76, 38.287, 2.336
ADDING YEAR AT END OF DATA; FIRST YEAR DISCARDED
ENTER "<FY>, <COST OF CONSTRUCTION >, <E&D COST>"
>0, 0, 0


ENTER "<COMMAND ID>, <DATABASE ID >"
OR "M" FOR MENU OR "Q" TO QUIT
>
```

Figure 4. Change a Division/District Database command.

Display a Division/District Database

This command displays the database for a specified Division/District, either on the graphic screen or on a hardcopy device, at the user's option. Figure 5 demonstrates the use of this command, and Figure 6 shows a sample display.

Perform Regression Analysis

This command performs multiple linear regressions and statistical analyses necessary to determine the forecasting model for the specified Division/District database. There are no further user prompts for this command.

Display Model Equation and Statistics

This command displays the forecasting model and statistics for the specified Division/District, either on the graphic screen or on a hardcopy device at the user's option. Figure 7 demonstrates the use of this command, and Figure 8 shows a sample display.

Plot E&D Cost/Rate Curves

This command plots the E&D cost and E&D rate predictions vs. estimated cost of construction for the next fiscal year for the specified Division/District. Output is displayed on either the graphic screen or on the digital plotter at the user's option. If a plot over the entire allowable range for estimated cost of construction is not desired, a subrange may be specified. Figure 9 shows an example of using this command, and Figure 10 shows a sample plot made by the digital plotter.

Forecast E&D Cost/Rate

This command calculates and displays the predicted E&D cost and rate for the next fiscal year as a function of the estimated cost of construction for the specified Division/District. The system prompts the user for the estimated cost of construction and displays the forecasts as shown in Figure 11. A zero estimated cost of construction value will terminate the command.

```
DISPLAY A DIVISION/DISTRICT DATABASE

DATABASE 1 FOR DIVISION/DISTRICT ALASKA

WHICH DEVICE "SCREEN" OR "HARDCOPY"?
>HARDCOPY

ENTER "<COMMAND ID>, <DATABASE ID >"
OR "M" FOR MENU OR "Q" TO QUIT
>
```

Figure 5. Display a Division/District Database command.

DISPLAY A DIVISION/DISTRICT
BALTIMORE (CONTRACT)

FY	CONSTRUCTION COST (MILLION $)	E&D COST (MILLION $)	E&D RATE (%)
69	35.697	1.345	3.77
70	46.865	2.051	4.38
71	86.439	3.731	4.32
72	133.997	5.961	4.45
73	152.460	7.028	4.61
74	152.560	6.462	4.24
75	128.000	5.655	4.42
76	106.050	4.632	4.37
77	138.535	6.361	4.59

Figure 6. Sample database display.

```
DISPLAY MODEL FUNCTION AND STATISTICS


WHICH DEVICE "SCREEN" OR "HARDCOPY"?
>HARDCOPY


ENTER "<COMMAND ID>, <DATABASE ID>"
OR "M" FOR MENU OR "Q" TO QUIT
>
```

Figure 7. Display Model Equation and Statistics command.

```
DISPLAY MODEL EQUATIONS AND STATISTICS
BALTIMORE (CONTRACT)


FY69 THRU FY77 DATA


E&D COST = -0.217 + 0.0461C + 0.000T + 0.00000CT


STANDARD ERROR OF THE ESTIMATE:    S = 0.182
COEFFICIENT OF DETERMINATION:      R**2 = 0.993


E&D COST IN MILLIONS OF DOLLARS
C = ESTIMATED COST OF CONSTRUCTION IN MILLIONS OF DOLLARS
T = TIME, WHERE FY77 = 9, FY78 = 10
```

Figure 8. Sample Model Equation and Statistics display.

```
PLOT E&D COST/RATE CURVES


ENTER DEVICE:  "1" FOR GRAPHIC SCREEN, "2" FOR DIGITAL PLOTTER
>2
ENTER ESTIMATED COST OF CONSTRUCTION RANGE:  "<MINIMUM>, <MAXIMUM>" OR CR
>(return)


TO PLOT GRAPH, PRESS RETURN
WHEN THE GRAPH IS FINISHED, PRESS
RETURN AGAIN TO CLEAR THE SCREEN
(return)
(return)


ENTER "<COMMAND ID>, <DATABASE ID > "
OR "M" FOR MENU OR "Q" TO QUIT
>
```

Figure 9. Plot E&D Cost/Rate Curves command.

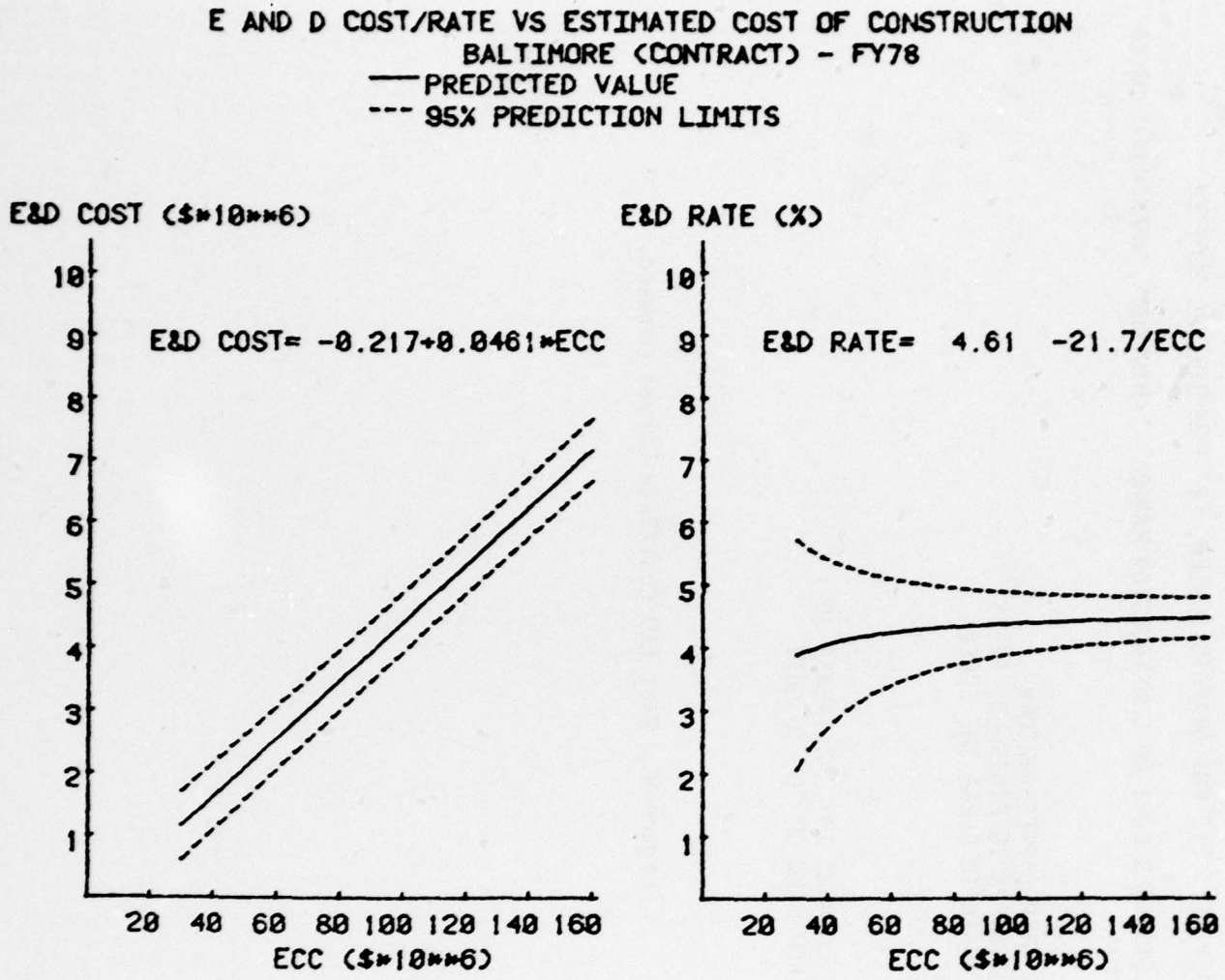

Figure 10. Sample plot of E&D Cost/Rate curves.

```
FORECAST E&D COST/RATE
ALASKA
FY77


ENTER "<ESTIMATED COST OF CONSTRUCTION>" (MILLION $: "0" TO QUIT)
>40


E&D COST = 2.50 + 0.60 MILLION DOLLARS (95% PREDICTION LIMITS)
E&D RATE = 6.21 + 1.59 PERCENT (95% PREDICTION LIMITS)


ENTER "<ESTIMATED COST OF CONSTRUCTION>" (MILLION $ = "0" TO QUIT)
>0


ENTER "<COMMAND ID>, <DATABASE ID >"
OR "M" FOR MENU OR "Q" TO QUIT
>
```

Figure 11. Forecast E&D Cost/Rate command.

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